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INSTRUMENTS CORP.

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Federal Communications Commission
1919 M. Street, N.W.
Washington, D.C. 20554

RE: NPRM, ET Docket 93-62

Dear Sirs:

I would like to comment on the proposal to adopt the ANSI standard C95.1-1992 to establish FCC mandated RFR guidelines for radiation standards, and in particular the NAB's proposal to allow demonstration of compliance by the use of charts and graphs rather than by measurement.

With respect to the use of charts and graphs, it is well known that in many situations RF radiation can be reflected from walls, fences and other structures, creating localized hot spots which can be up to 10 Db higher than the level predicted by charts and graphs. I believe that transmitter operators should be required to perform area swept, peak hold, measurements near structures where a 10 Db increase in radiation level could result in public exposure levels which exceed the (new) established standards.

With respect to the standards which are set, I would like to point out that the ANSI levels are **not the known safe levels of exposure**. Rather the ANSI levels are set at an arbitrary value lower than that which is known to cause **thermal effects**. It should also be noted that ANSI only reviewed **peer reviewed** literature which was available at the time, and specifically ignored much of the recent research which had not been available long enough for the peer review process, or for which the researcher had not sought publication in peer reviewed journals. Consequently, I believe that the ANSI review was incomplete.

Several researchers have recently found evidence of **nonthermal** interaction between RFR and cell metabolism at levels which are far below those needed to create the thermal effects which the ANSI RFR levels protect against. For this reason, I believe that the general public should not be needlessly exposed to RFR, even at levels below those set by the ANSI standards.

I would propose that the new FCC standards include a much more stringent maximum exposure level for new transmitter sites of 1μ watt / cm^2 for schools, offices, apartments and other areas where large numbers of people would be repetitively exposed to RFR over long periods of time, and where alternate transmitter sites can be found. In the interest of minimizing impact on existing sites, I would not propose that existing transmitters be

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bound by this regulation, only new transmitters. I would also propose that new transmitters operators be allowed to exceed this level if there were no other suitable site and if they petition and gain approval from the local community government agency after suitable public hearing and environmental study.

The point of my proposed new regulation is to prevent needless exposure of large segments of the population. I have personally witnessed instances where transmitters were installed on school property and next to apartment buildings, when perfectly suitable sites were available only a few hundred yards away. I believe that it is foolish and unethical for transmitter operators to create unnecessary exposure to large groups of school children and apartment dwellers when long term exposure to this radiation can not be shown to be safe. That such exposure is unwarranted is especially true when the radiation could be lowered by one or two orders of magnitude by simple moving the transmitter a block or two down the street. Such regulations would entail little or no cost to the transmitter operator, and might save countless illnesses five or ten years in the future.

Thank you for the opportunity to present my opinions. For your review and information, I have attached a short study supporting my above technical assertions.

Sincerely,

J. Carl Cooper
C.E.O. and
Director of Engineering

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REVIEW AND COMMENTS ON POSSIBLE NONTHERMAL EFFECTS OF LOW LEVEL RADIO FREQUENCY RADIATION

Prepared by:
J. Carl Cooper
Pixel Instruments Corp.
Prepared 4/25/94

BACKGROUND

Many cellular telephone and wireless communication services have proposed installing transmitters near schools, apartments, offices and other locations where there are high public occupation densities for long periods of time.

In many instances, the transmitter engineers who perform the technical studies of the radiated power levels perform calculations of radio frequency radiation (RFR) exposure based on assumptions which do not represent a worst case scenario. Although the factors which contribute to worst case rarely occur, it is believed that a prudent decision maker would also wish to change the technical assumptions to more pessimistic views, which would give power level calculations which are more accurate for a worst case or hot spot conditions. Taking such a pessimistic approach will of course give rise to a lower probability of representing the actual exposure encountered, but there is a finite probability of the worst case occurring, and it is believed that the worst case should be addressed in order to present a proper level of disclosure and understanding of the potential problems. The need for such a view is especially pertinent for the present consideration, since any error or oversight could have grave consequences for the health of dozens or hundreds of young children or other members of the public who are forced to accept such exposure without their consent or knowledge.

The following is a summary areas where assumptions could be changed to reflect a more pessimistic view:

1. Calculations often discount the effects of radiation reflected from structures such as fences, buildings, building structural elements and the ground. Simply explained, a reflection of the transmitted beam created a void in the area it is reflected from, and a higher intensity in the area the beam is reflected to. These reflections can create hot spots where reflected beams converge. This effect is known as Rayleigh fading and is usually of concern with respect to the void areas and resulting loss of service. Although the prediction of the locations and intensities of hot spots is extremely difficult, it is realistic and prudent to assume that these hot spots may be present in the apartments, offices, classrooms and playgrounds.

2. Calculations often recites (correctly so) that

building materials attenuate the RF power densities by a factor of approximately 10. This is true in general, but the effect on radiation passing through a single pane of glass window or a single wooden wall is much lower. In addition, there is no such attenuation for the open areas such as parks or playgrounds. It is believed that in order to arrive at a worst case calculation this building attenuation effect should be ignored and ground reflection included.

3. It is often cited that the most stringent general population exposure standard in the US is defined by the NCRP[1] and which is derived from the ANSI-C95.1-1982 standard which was generated with the rates of energy transfer (heating) of the human body as a basis. The ANSI-C95.1-1982 report was in turn generated from the older ANSI-C95.1 report from 1974, which in turn was generated from a 1957 Tri-Service Committee report, all of which are based solely on thermal effects on the human body. It should be noted that the criteria used by the US agencies ANSI, NCRP, NIOSH and OSHA for setting exposure levels is mainly related to the heating experienced by the exposed tissue[2]. In the setting of criteria by these US agencies, there has been little or no consideration of non heating effects such as interaction with the central nervous system[3]. It is believed that basing safety considerations for the students, office workers or other members of the general population <u>solely</u> on these thermal exposure criteria is improper.

4. Environmental Impact reports sometimes touch on scientific studies of low level effects of electromagnetic radiation below those in the NCRP guidelines, but discount the studies as lacking specific peer reviewed evidence related to this particular application. It is believed that these reports should be taken more seriously. Even if experts have not found specific scientific evidence **proving** such low level effects, one should not discount any available evidence that there **may** be adverse effects. Further, in view of the much more stringent exposure levels adopt-

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1. NCRP Report No. 86, Table 17.1

2. Herman Cember, Introduction to Health Physics, 2nd ed. (New York: Pergamon Press, 1989), p. 454

3. Herman Cember, Introduction to Health Physics, p. 457, "···the proposed new standards consider the relative biological effectiveness, which is based on the frequency dependent penetration depth and on the electrical and thermal properties of the tissues that consequently absorb energy from the electromagnetic field, of the various frequencies."

ed by various European countries[1] it is believed that serious consideration should be given to the effects of such exposure on the central nervous system.

POWER DENSITY CALCULATIONS

Simple exposure levels of the unobstructed main beam of the transmitters can be calculated by anyone having a knowledge of high school algebra. The equation[2] for calculating power density in watts/cm² at a point of interest in the main beam of an antenna is given by:

$$S=\frac{EIRP}{4\pi R^2}$$

Where EIRP = equivalent isotropic radiated power which is 1.64 times 100 watts ERP = 164 watts

R = the distance of the point from the antenna in centimeters

For situations where the point is above, below or to the side of the main beam, the calculated value for the field strength in the main beam (above) is decreased by a factor which is most easily derived from the antenna charts.

It should be noted that the probability of high exposure to RFR to a person in the area immediately surrounding the transmitter site is fairly high, and can be substantially increased by reflections. It is generally not known before hand if structures near the transmitter will actually reflect radiated energy in significant amounts, but it is reasonable to be concerned that they could. It is difficult to accurately model reflections due to the number of variables, thus charts and graphs of RFR vs. distance from the transmitter are of little value. Actual measurements would need to be made to determine the nature of the reflections and their intensity.

Although the occurrence of high intensity hot spots is unlikely at a particular point, it is highly likely over a large area such as a school. It would be prudent to make RFR calculations with the assumption that the radiation reflected from buildings, building structural elements, fences and the ground which will create hot spots where the reflected beams will converge somewhere in and around public areas.

It is known that the Rayleigh fading types reflections of

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1. Ibid, "In the U.S.S.R., the maximum occupational exposure limits are: 10 microwatts/cm² for continuous exposure ···."

2. Reference Data for Radio Engineers, 6th ed. (Indianapolis: ITT, 1975), chp 27.

energy occur[1] and create an increase in signal strength in the order of 10Db or 10 times the average[2,3] power density expected considering only the direct and ground reflected beams. This 10Db reflection coefficient is believed reasonable to use to calculate the worst case value of a hot spot created by reflections of the main beam.

BIOLOGICAL CONSIDERATIONS AND EXPOSURE LIMITS

While it is correct that the ANSI exposure guidelines are the most stringent U.S. standard, this should not be the whole consideration. One who is looking to this problem should not be trying to obtain data for a legally defensible position in avoidance of liability should health problems occur in population near a transmitter, rather one should be looking to guarantee that there is absolutely no risk to any of the population. It is one matter to avoid liability, and quite another to guarantee safety.

As it was previously pointed out, the ANSI standards were generated mainly out of concern for the heating effects on the organs of the human body. It is well known that various organs such as the testes, cornea and thyroid can be adversely affected by heating caused by radiation. The U.S. standards set an exposure level which provides a reasonable safety factor below that which the body can dissipate through blood circulation and respiration[4]. There are no guidelines or limits in the U.S. which take non thermal effects into account. The ANSI standard report briefly touched on scientific studies of low level effects of electromagnetic radiation below those in the ANSI levels, but discounted the studies as lacking specific evidence related to this particular application.

While documentation on the non thermal effects of low level radiation is difficult to find, it should be noted that several authorities refer to those effects in their treatment of exposure levels. For example, the Federal Communications Commission states:

> "At relatively low levels of exposure to RF radiation, i.e., field intensities lower than those that would produce significant and measurable heating, the evidence for production of harmful biological effects is less clear. <u>A number of reports have appeared in the</u>

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1. William C.Y. Lee, Mobile Cellular Telecommunications Systems (McGraw-Hill, Inc., 1989), p. 12 et. seq.

2. William C.Y. Lee, Mobile Cellular Telecommunications Systems, p. 12.

3. Reference Data for Radio Engineers, pg 28-18.

4. FCC/OET Bulletin No. 56, 3rd ed. (Washington D.C., FCC, Jan. 1989).

Russian and East European literature claiming a wide range of low-level biological effects. The low-level effects on animals and humans reported in the Soviet and East European literature have included behavioral modifications, effects on the blood-forming and immunological system, reproductive effects, changes in hormone levels, headaches, irritability, fatigue, and cardiovascular effects"[1] [emphasis added].

And, Cember[2] has noted:

"laboratory studies with animals at relatively high exposure levels confirm changes in electroencephalograms, alteration of the blood-brain barrier, alteration of cell membrane permeability, hematologic effects, teratogenic effects, central nervous system effects, and behavioral changes. Until dosimetry problems are solved and uncertainties in dose-response relationships for repeated and for continuous low-level exposure are eliminated, a prudent degree of conservatism must continue to be exercised in the control of hazards from microwave and radio-frequency radiation".

With these statements in mind, it should be noted that some European countries, and the former U.S.S.R. set an exposure level of $10\mu w/cm^2$ for occupational exposure and an exposure level of $1\mu w/cm^2$ for general population exposure[3]. There is obviously a great disparity between the ANSI and U.S.S.R. standards. One possible reason for this difference was given by Steneck[4] "In early RF/microwave studies conducted in the Soviet Union and in Poland (and probably also in Czechoslovakia), there existed teams of physicians and special clinics for the study of occupational diseases which were involved in the physical exam processes. In many instances, particularly in the military medical community, the individuals were brought into a hospital for several days so as to conduct the complete examination. On the other hand, most studies conducted in the West were based on questionnaires, and *not* on actual examination of the 'patients'".

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1. FCC/OET Bulletin No. 56, page 5.

2. Herman Cember, Introduction to Health Physics, 2nd ed. (New York: Pergamon Press, 1989), p. 449 et. seq.

3. Herman Cember, p. 457.

4. Nicholas H. Steneck, Ed.,Risk/Benefit Analysis: The Microwave Case (San Francisco: San Francisco Press, Inc., 1982), 58.

As further interest, a 1962 study by Letavet and Gordon[1] of 525 workers who were chronically exposed to microwave energy found that the workers experienced bradycardia, hypotension, hyperthyroid and an increase in blood histamine level, all of which were suspected as being caused by or related to the radiation exposure.

It has also been reported by Musil and Tuha[2] that workers in the microwave field experienced subjective health effects of headaches, eyestrain, fatigue, dizziness, impaired memory and other effects as a result of their exposure.

Clearly, we do not know all there is to know about the effects of exposure to the levels expected for the Fisher school installation. Clearly too is the strong suggestion that such exposure can cause adverse health effects.

SOME FACTS FOR A COMMON SENSE REVIEW

While not scientific, some facts and observations are worth mention.

The ANSI permitted RFR radiation which some public members such as students could receive on a continuous work day basis is several hundred $\mu w/cm^2$. While this level could only be found at hot spots in and around the transmitter, and would be modulated in intensity with the usage of the transmitter, it could happen. <u>It should be noted that this exposure which a person could receive is far above the U.S.S.R. exposure level of $1\mu w/cm^2$ for general population exposure</u>. It would be prudent to bear this in mind when making decisions about the safety of the public.

The level of possible exposure can be compared to the normal background electromagnetic radiation levels which the general population experiences[3]. The median population exposure, based on measurements of several cities with a combined population of 8,300,000 was found to be $.014\mu w/cm^2$. In the same survey, it was found that 99% of the population was exposed to less than $1\mu w/cm^2$.

Most people can readily recall past instances where the public was needlessly exposed to health risks because the scientific community was unable to prove that a particular technology or device was dangerous. Such is especially true for new devices

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1. Letavet, A. A., and Gordon, Z. V. Biological action of ultra high frequencies. U.S.S.R. Academy of Medical Science, Translation 12 471, U.S. Joint Pub. Res. Service, 1962.

2. Marha, K., Musil, J. and Tuha, H. Electromagnetic Fields and the Life Environment. San Francisco Press, San Francisco, 1970

3. Herman Cember, Introduction to Health Physics, p. 457.

or new uses of technology. Radium pills, shoe fitting x-ray machines, cocaine elixirs, smoking, silicone breast implants, and a host of chemicals in everyday use which were found to cause cancer are just a few examples.

The radio frequencies used by cellular telephone and wireless communications technology have not been previously used in a way which exposed any large number of population to their effects over long periods of time. The long term human effects of this energy are largely unknown. This is not an exposure such as that from broadcast radio stations or power lines where we have decades of experience to rely on. It is interesting to note that generally objects which are in the order of .4 times the wavelength of the electromagnetic energy are most susceptible to absorbing that energy. The wavelength of the cellular telephone emissions range from 13" to 15", making objects roughly 5" to 6" in length particularly susceptible. Several body organs of children fall into or near this range.

CONCLUSION

The installation of the transmitters at Fisher school can not be proven to be safe by the weight of scientific evidence. The current guidelines which have been cited by Dr. Polson are based only on old thermal effect research and are thus inadequate as conclusive proof of safety. At best it can only be said that we do not know what safe levels are. There is considerable evidence which leads to the conclusion that the installation may very well cause health problems. The fact that the exposure levels may well be higher than that established as safe in the U.S.S.R. should also be a serious concern. Based on all the above, it would not be wise to risk the health of the children attending Fisher by allowing the transmitter installation.

SOLUTIONS

It would seem that if the radiation level could be reduced to a level which is consistent with the background exposure for the general population, then the safety concerns would not be as great. Moving the transmitters to accomplish this might be possible with some flexibility on GTEs part. As one possibility, two transmitter sites could be used, one on each side of the school with antenna pointed away from the school. A transmitter located on top of the gym pointing 40° TN and two at the presently proposed site pointing 160° and 280° could be arranged to give essentially the same coverage. Such an arrangement would reduce the school radiation considerably, quick calculations indicating in the order of 1000 to 1. Changes in location would affect the radiation of the surrounding neighborhood, and in particular Van Meter school so calculations would need to be made for those areas as well.

Raising the antenna height so that the main beam would be sure to clear the top of the school would be another improvement. The higher beam would eliminate or reduce the downward reflections would also reduce the radiation levels considerably. Mounting all 3 antenna on top of the gym building or one of the other buildings might accomplish this, and quick calculations indicate that school radiation level reductions in the range of 5 to 1 might be achieved. The downward radiation from the side lobes could be shielded from radiating downward, and the main beam would be well above the classroom. In addition, the installation costs would benefit from the availability of power in the building, and possibly some of the building space could be made available to house the transmitters, thus saving the cost of a separate transmitter building.

There appears to be nothing terribly unique about the Fisher site, save the financial benefit which the school would gain. While the school is certainly in need of any and all sources of revenue it can get, all would agree that the safety of the children makes the financial issue moot. There would appear to be several other sites which could be used which would provide essentially the same coverage while considerably reducing the risk to the students. Remember that the radiation decreases with the square of the distance, so that moving the antenna another 500 feet away from the school (double distance) would reduce the radiation by 1/4. Moving the antenna across the highway would probably reduce the radiation to 1/10 or so. There appear to be several sites around Vasona which could be considered.